NASA-CR-196798

22350
41P

SEMI-ANNUAL PROGRESS REPORT

NASA GRANT NAG8-767

GROWTH OF ZINC SELENIDE CRYSTALS BY PHYSICAL VAPOR TRANSPORT IN MICROGRAVITY

(NASA-CR-196798) GROWTH OF ZINC SELENIDE CRYSTALS BY PHYSICAL VAPOR TRANSPORT IN MICROGRAVITY Semiannual Progress Report, 11 Feb. - 10 Aug. 1994 (Alabama Univ.) 42 p

N95-70168

Unclas

29/29 0022350

Period of Performance
2/11/94 - 8/10/94

Principal Investigator
FRANZ ROSENBERGER

Report Prepared by
MICHAEL BANISH

Center for Microgravity and Materials Research
University of Alabama in Huntsville
Huntsville, Alabama 35899

General Status

In discussions with our CoTR and other interested MSFC personnel in January , 1994, it was decided to coordinate the efforts under this grant with those to be performed under Grant NAG8-767 "Growth of ZnSe Single Crystals by Physical Vapor Transport in Microgravity". This consolidation occurred due to Dr. Franz Rosenberger becoming the principal investigator of NAG8-767. The goal of this coordinated research will be the growth of CdTe single crystals of high structural and compositional quality using the Effusive Ampoule Physical Vapor Transport method.

Therefore, the revised research tasks are:

a) Design and construction of a three-zone furnace. Though similar in dimensions to the furnace previously used for the growth of ZnSe, this new design is to provide for greater flexibility in the adjustment of temperature profiles, and ensure a longer lifetime of the heating element. In addition, the design should accommodate a low-power, high-temperature microscope for *in-situ* viewing of the crystal.
b) Determination of the most advantageous ampoule design for seeded growth. In particular, growth should proceed without contact between the crystal and side wall.
c) Crystal growth using a variety of seeds with orientations ranging from (100) to (511) to determine which interface orientation leads to lower twin and etch pit densities.
d) Characterization of the grown CdTe crystals, including:
   - etch pit densities by etching and optical microscopy,
   - precipitate density and physical structure by infrared microscopy,
   - twin boundary distributions by multi-direction sectioning.
e) Correlation between seed orientation, growth conditions and crystal quality.

Work Performed

During this reporting period we have concentrated on the effects of ampoule modifications on the resulting crystal shape. This is to ensure that growth proceeds without contact with the ampoule wall. This is primarily accomplished by extending the solid silica-glass seed pedestal/light pipe up into the ampoule rather than ending it at the ground-glass joint, see figure . In order to obtain the optimum ampoule configuration for the new furnace; we have also modified the inner diameter of the ampoule surrounding the pedestal and growing crystal. Furthermore, we have been investigating various total light pipe lengths. The bottom end was extended to terminate at various temperatures. We are continuing these tests at the present. Depending on the results we may add an independent heater to the bottom of the light pipe. Finally, we have positioned the source reservoir in the ampoule such that compaction into the cap occurs in the beginning of a crystal growth run.

To date results obtained with the new furnace and ampoule design have been very encouraging:

1) The microscope-viewing and illumination-rod ports through the heating elements were found to not break the cylindrical symmetry of the temperature field. Hence, we can completely eliminate the "saddle" configuration of the crystal shape experienced in the earlier furnace.

2) The crystal interface is slightly convex to the vapor. Thus possible secondary nucleation at the crystal edges is crowded out and most of the boule remains single crystalline.

3) The crystal grows with contact to the pedestal only. The crystal does not adhere to the pedestal and can, thus, readily be removed from the ampoule.

We have had some problems with the vacuum system. After consultation with the manufacturer we have rebuilt the mechanical pump. Since this did not solve the problem, we are now servicing the turbo pump itself.

Presentations

Michael Banish was invited to present the work performed under this grant at the Eighth International Conference on Vapour Growth and Epitaxy in Freiburg, Germany, July 24-29. His presentation "Effusive ampoule physical vapor transport - Application to II-VI compounds" was well received. Several groups showed an interest in using this technique for the growth of II-VI and other congruently vaporizing materials.

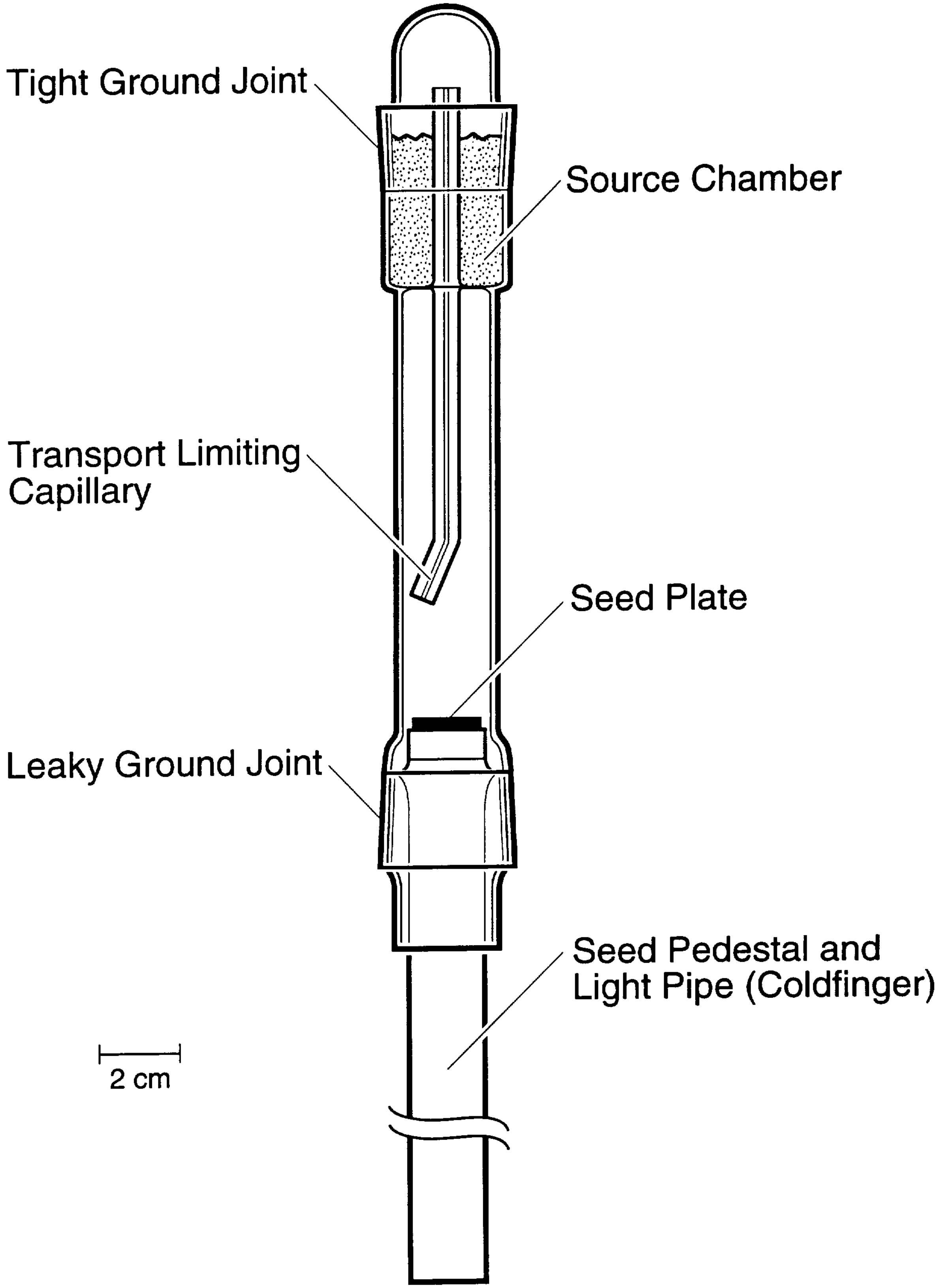

Fig. 1. Effusive PVT Ampoule